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MASS TO LIGHT RATIOS OF CLUSTERS HRADECKY ET AL.

MASS TO LIGHT RATIOS OF GROUPS AND CLUSTERS OF GALAXIES

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abstract

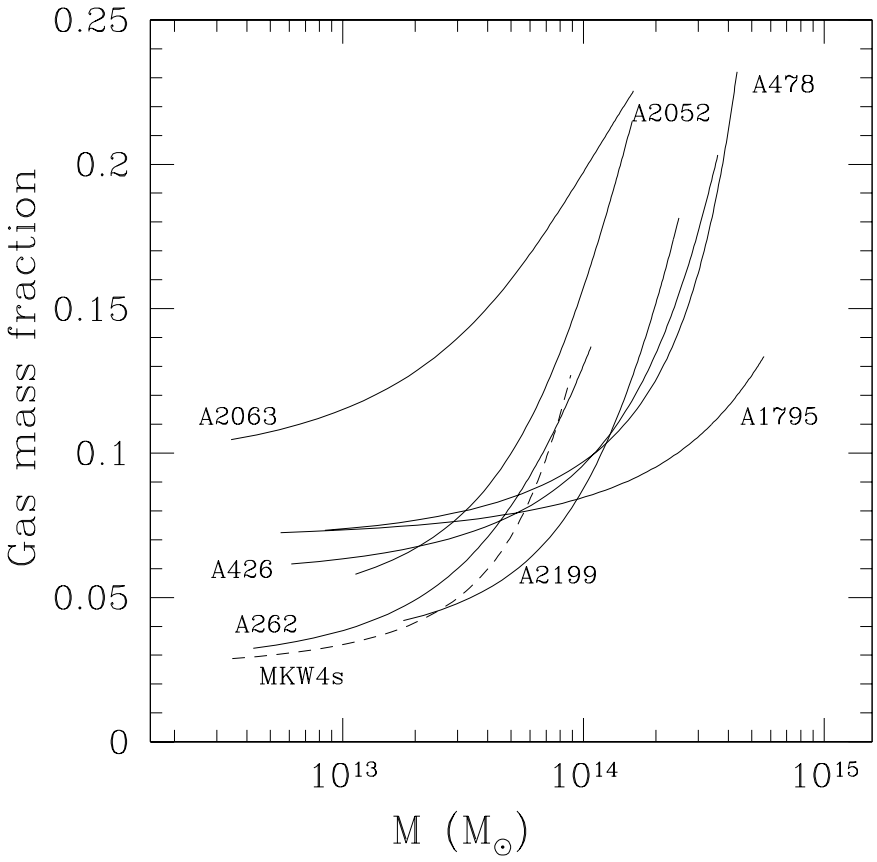
We constrain the mass-to-light ratios, gas mass fractions, baryon mass fractions and the ratios of total to luminous mass for a sample of eight nearby relaxed galaxy groups and clusters: A262, A426, A478, A1795, A2052, A2063, A2199 and MKW4s. We use ASCA spatially resolved spectroscopic X-ray observations and ROSAT PSPC images to constrain the total and gas masses of these clusters. To measure cluster luminosities we use galaxy catalogs resulting from the digitization and automated processing of the second generation Palomar Sky Survey plates calibrated with CCD images in the Gunn-Thuan g, r, and i bands.

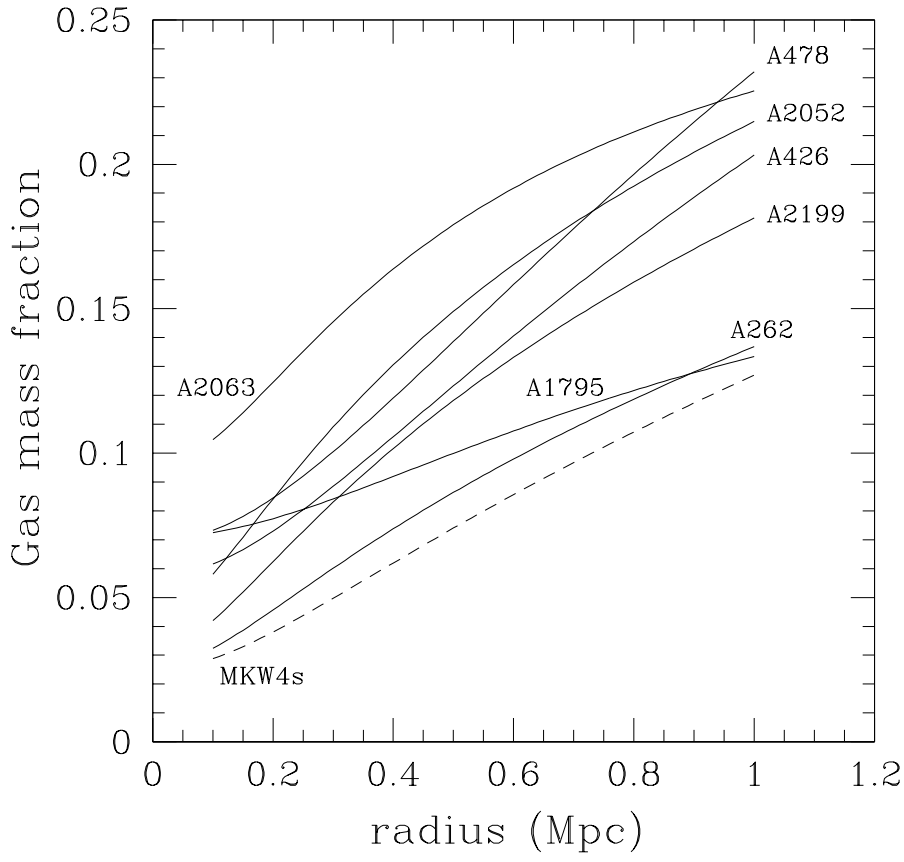
Under the assumption of hydrostatic equilibrium and spherical symmetry, we can measure the total masses of clusters from their intra-cluster gas temperature and density profiles. Spatially resolved ASCA spectra show that the gas temperature decreases with increasing distance from the center. By comparison, the assumption that the gas is isothermal results in an underestimate of the total mass at small radii, and an overestimate at large cluster radii.

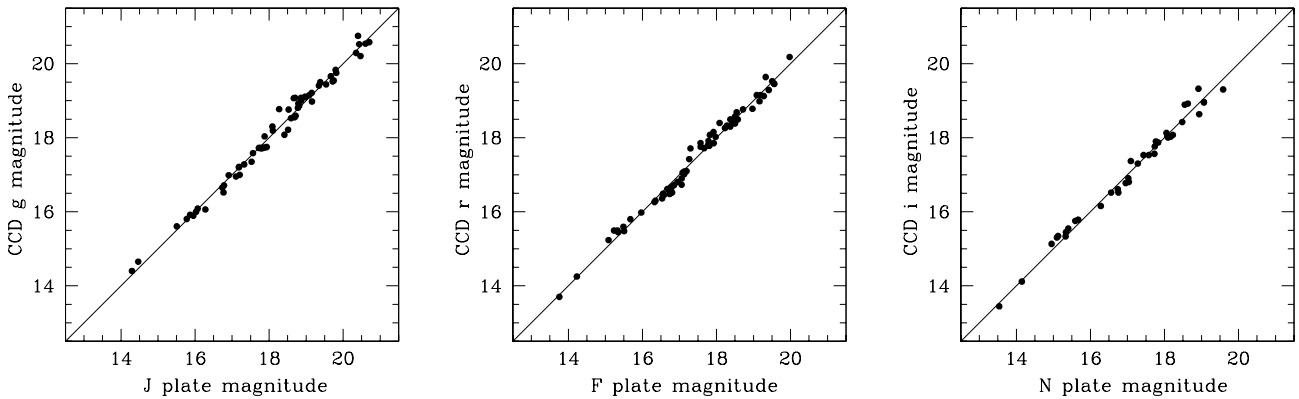
We have obtained luminosity functions for all clusters in our sample. After correcting for background and foreground galaxies, we estimate the total cluster luminosity using Schechter function fits to the galaxy catalogs. In the three lowest redshift clusters where we can sample to fainter absolute magnitudes, we have detected a flattening of the luminosity function at intermediate magnitudes and a rise at the faint end. These clusters were fitted with a sum of two Schechter functions. The remaining clusters were well fitted with a single Schechter function.

Assuming $H_0 = 50\ h_{50}$ km s$^{-1}$ Mpc$^{-1}$, the measured mass-to-light ratios are $\sim 100\ h_{50}\ \mathrm{M}_\odot/\mathrm{L}_\odot$. This, along with a high baryonic fraction, is indicative of a low density universe with $\Omega_0 \sim 0.15 - 0.2$.

Cosmology — galaxies: clusters: individual — intergalactic medium — X-rays: galaxies


0.25
0.2
0.15
0.1
0.05
0
Gas mass fraction
A478
A2052
A2063
A1795
A426
A2199
A262
MKW4s
$10^{13}$
$10^{14}$
$10^{15}$
M ($M_\odot$)


0.25
0.2
0.15
0.1
0.05
0
Gas mass fraction
A478
A2052
A426
A2199
A262
A2063
A1795
MKW4s
0
0.2
0.4
0.6
0.8
1
1.2
radius (Mpc)


CCD g magnitude
J plate magnitude
CCD r magnitude
F plate magnitude
CCD i magnitude
N plate magnitude
14
16
18
20